

Use Case Study

Knowledge management in Graphene research and development

Version 1.1

Dr. Dirk Ortloff, Dr. Jens Popp

November 11, 2020



© DO-IT-Service GmbH

<https://www.do-it-service.de/>



© camLine GmbH

<https://www.camline.com/>

As in many other areas, digitization is often an open/underrepresented topic in research&development of high-tech manufacturing processes. This causes a lot of friction in the communication and coordination in small as well as large engineering departments. One major obstacle is the missing knowledge management across the complete organization. The introduction of a Process Development Execution System (PDES) can significantly improve knowledge management and facilitate internal communication and coordination.

The customer of this use case study is a small company in the field of graphene technology development with several research locations in a few countries. Historically, the company originated from basic research and commercializes these research results. Their current business model is based on the production and sale of functional graphene components.

The starting position: Chaos as a brake on innovation

Research and development collected large amounts of data, but these were mostly stored in unstructured form as data in laboratory books, Excel sheets, and files with different structures on file servers. The type of data collection, structuring, and storage often varied from project to project, from employee to employee, etc. The bottom line was that research and development were virtually "drowning" in data. Nevertheless, information is hardly ever extracted and retrieval of data, information and knowledge were extremely difficult - especially due to the distribution over several locations.



Figure 1: The search for knowledge often resembles the search for the proverbial needle in a haystack [Troscianko 2020]

The project goal: More structure, more knowledge

The task was to build up an effective data and information management for research and development and to establish it for coordination across the locations. Based on this, a knowledge management system for the R&D area was to be created to take into account the motto "If only Company A could use all the knowledge that its employees together know". To do this it was necessary to find a structuring approach for the volatile, constantly reinventing community of researchers that would bring transparency to existing manufacturing knowledge, technological possibilities, the current status of projects, etc.

Fast quick wins and long-term goal

As a first step, an assessment of all sites got carried out. That assessment involved a detailed survey of which data, information, and knowledge were already available in digital format at which locations and assessed the structure of those storages'. From this, the most minimally invasive, unified future structuring was derived, discussed with all stakeholders, and after some amendments approved by all parties.

Subsequently, an instance of the XperiDesk Process Development Execution System (PDES) got set up as Software as a Service (SaaS) in the Cloud tightly secured by various security measures. This system serves as the future digitization and information and knowledge management platform. The reason for opting for a SaaS deployment rather than on-premise deployment was the easier integration of several sites as well as limited resources to maintain their own IT resources.

As a next step, the XperiDesk importing mechanisms for pulling data from various sources came into play. Figure 2 depicts the architecture of the system and its importing modules. They can pull data from different sources and export the re-structured, selected data to various data analysis tools and formats. The module XperiEIC got set up to retrieve, extract, and structurize parametric data from within text and Excel files of several different file types. Furthermore, XperiFLC got configured to import all the raw data files from manufacturing and metrology being located on several different servers and file systems. All data imported, together with its full context, was populated into the previously agreed structure of a semantic network. As a result, management and engineering gain much more oversight about the current status of the different development projects and can access the extracted knowledge from the experiments much easier.

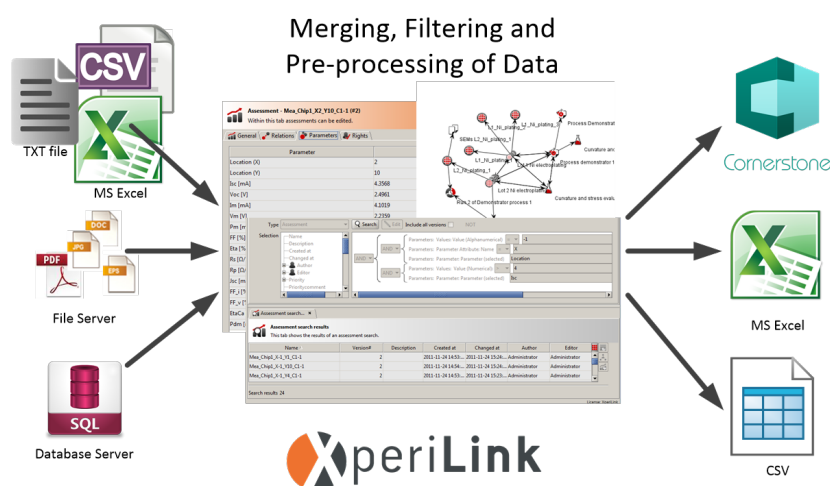


Figure 2: Import&Export architecture of the XperiDesk platform for automatically importing, structuring, retrieving, and exporting/analyzing

Afterward, a project for change management and organizational development got launched to create the buy-in and establish the added value of the new structures and oversight. The significant objective was to ensure that the life of the researchers will be more efficient and more effective in the long term, despite the necessary changes to the working methodology. Additionally, mental hurdles were to be removed by initial quick wins. Regular question/answer rounds, monitoring of the usage for a sustainable shift of the working environment to the new tool, support of the client in operating the platform, and a constant post-qualification of the (new) employees rounded off the introduction. They were an essential part of this effective digitization measure in research and development.

Added value for the employees

The added value for the employees results from a variety of simplifications in their daily work. The most important improvements are:

- Regular reporting has been greatly simplified and made more efficient, as the generation of reports based on up to date data only requires a push of a button. No manual collection and re-arrangement of data necessary anymore.
- Access to the information and knowledge of colleagues, about 20 engineers across several sites, has been greatly simplified and made considerably faster, especially in cases where colleagues were not promptly available.
- Annoying tasks of data collection and structured filing got automated fully by the XperiDesk importing capabilities. This automation freed up significant time such that the engineers can concentrate on the creative tasks now.

Added value for the company

- a 20% increase in the effectiveness and efficiency of research & development projects. Several improvements jointly created these efficiency gains. The main gain results from preventing re-doing experiments that have been performed previously, sometimes in a different location. Another significant contribution to the improvements came from the removal of manual data collection and arrangement.
- a significant increase in the work satisfaction of the employees. This was a result of relieving the engineers of uncreative tasks like manual data collection and manual arrangement into structures and the manual preparing data for data analysis.
- greatly improved communication and cooperation between the different locations. The XperiDesk information platform provides up-to-date information and knowledge, as well as all detailed background data all the time. This centralized, holistic body of information facilitates the synchronization between the locations and gives fast access to desired information instead of relying on direct communication between the engineers in different time zones.
- avoidance of a large number of experiments that were previously conducted twice due to poor communication.
- considerably reduced loss of knowledge in case of employee fluctuation.

References

Troscianko, Jolyon (Oct. 26, 2020): *Needle in the haystack, credits to Jolyon Troscianko*. In: url: <http://www.jolyon.co.uk/illustrations/basic-vision/> (cit. on p. 2).